

Re-generable Field Emission Cathodes, Phase I

Completed Technology Project (2013 - 2013)



Project Introduction

A significant challenge in scaling micro-propulsion devices up to 100s of Watts as well as scaling macro devices down to sub-kiloWatt level is the lack of a compatible neutralizer technology in the meso scale. Sub-kiloWatt EP systems require cathode technology that can produce sufficient current while consuming little or no gas or power. The most promising technology for meso-scale neutralizers is field emission. In field emission, electrons are extracted directly from a cold bulk solid material by an intense applied electric field at the solid-vacuum interface with no gas flow and no heating required. While many methods have been proposed to incorporate field-emission neutralizers in EP systems, the inherent fragility of the technology – specifically the reliance on solid structures with nanometer-radius tips – ensures that device failure due to tip degradation will be a near certainty for any application depending on field emission cathodes. The goal of research proposed here is to develop arrays of field-emission neutralizers for use in sub-1-kW EP that eliminate tip degradation not through attempts to minimize tip wear, but instead by incorporating self-assembling nanostructures that can repeatedly re-generate damaged emitter tips in space and fully restore the functionality of a damaged or degraded device.

Primary U.S. Work Locations and Key Partners

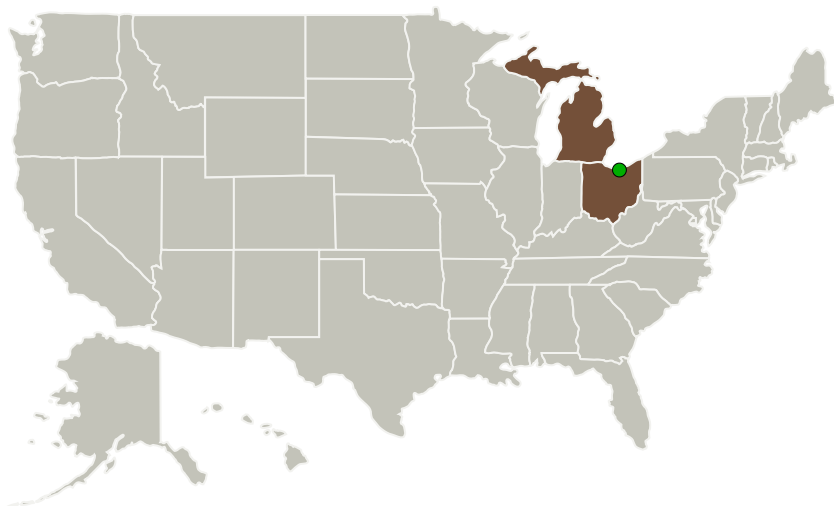


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Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Aerophysics, Inc.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Continued on following page.

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| Organizations Performing Work | Role | Type | Location |
|-------------------------------|-------------------------|-------------|-------------------|
| Aerophysics, Inc. | Lead Organization | Industry | Allouez, Michigan |
| ● Glenn Research Center(GRC) | Supporting Organization | NASA Center | Cleveland, Ohio |

| Primary U.S. Work Locations | |
|-----------------------------|------|
| Michigan | Ohio |

Project Transitions

**May 2013:** Project Start**November 2013:** Closed out**Closeout Documentation:**

- Final Summary Chart(<https://techport.nasa.gov/file/138447>)

Images

Project Image

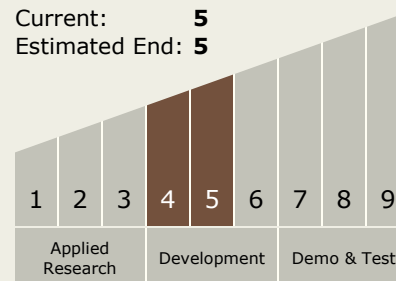
Re-generable Field Emission Cathodes

(<https://techport.nasa.gov/image/130598>)Project Management
(cont.)**Principal Investigator:**

Jason M Makela

Co-Investigator:

Jason Makela

Technology Maturity
(TRL)Start: **4**Current: **5**Estimated End: **5**

Technology Areas

Primary:

- TX01 Propulsion Systems
 - TX01.2 Electric Space Propulsion
 - TX01.2.2 Electrostatic

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System